AMENDMENTS TO THE CLAIMS

Claim 1 (Currently Amended) An optimizing method that optimizes, using a computer, a component mounting order in which a mounter, equipped with a mounting head, picks up, at maximum, L components, L being no less than 2, from an array of component feeders that hold components, and mounts the components on a board,

wherein the mounting head has, at maximum, L pickup nozzles attached thereto for picking up the components, ~~L being no less than 2~~, and

wherein a plurality of components, of which the mounting order is to be optimized, ~~include plural~~ includes a plurality of types of components ~~which are~~ to be picked up using no less than 2 pickup nozzles of different types, ~~and~~

the optimizing method comprising:

~~a nozzle set determination step of~~ determining a nozzle set, from a plurality of pickup nozzles, for mounting ~~all~~ the plurality of components ~~with~~ using a smallest possible number of tasks ~~task number~~, where a nozzle set is a combination of pickup nozzles in which (i) only the types of the pickup nozzles and a number of the pickup nozzles to be attached to the mounting head are previously set and (ii) a correspondence between the types of the pickup nozzles and mounting positions of the pickup nozzles is not previously set, and where a task is a group of components to be mounted by one iteration of ~~the~~ a repeated series of processes where the mounting head picks up, transports, and mounts the components; and

~~a mounting order determination step of~~ determining ~~the array~~ an order of the array of component feeders and ~~the~~ a component mounting order, while maintaining the determined nozzle set.

Claim 2 (Currently Amended) The optimizing method according to Claim 1,

wherein the pickup nozzles attached to the mounting head are interchangeable, and

wherein ~~in~~ the determination of the nozzle set determines ~~determination step,~~ a nozzle set ~~is determined, said nozzle set reducing~~ that reduces a mounting time in view of ~~the~~ (i) a number of times of interchanging the pickup nozzles for mounting the components and (ii) a total number

of tasks.

Claim 3 (Currently Amended) The optimizing method according to Claim 2, wherein, in the determination of the nozzle set ~~determination step~~, i) at least one kind of nozzle set is specified, ~~said~~ the specified nozzle set corresponding to the number of times of interchanging the pickup nozzles, ii) ~~the task number~~ a number of tasks required for mounting the plurality of components is calculated using the specified nozzle set, iii) a combination of the number of times of interchanging the pickup nozzles and the calculated ~~task~~ number of tasks required for mounting the plurality of components is estimated, and iv) the nozzle set is determined as a result of the estimation.

Claim 4 (Currently Amended) The optimizing method according to Claim 3, wherein the determination of the nozzle set ~~determination step includes:~~ further comprises:

further calculating~~a~~ the number of tasks ~~task~~ required for mounting the plurality of components by ~~number calculation step of~~ repeating the ~~processing of~~ calculating of the ~~task~~ number of tasks required for mounting the plurality of components using "n" kinds of nozzle sets, "n" being no less than 1, while incrementing ~~the~~ "n" by 1; and

~~a nozzle set number specification step of~~ calculating an evaluated value S, corresponding to the mounting time, according to a predetermined evaluation function, specifying a nozzle set of the "n" kinds ~~kind~~ of nozzle sets ~~set~~ corresponding to a combination of pickup nozzles in which the evaluated value S is the smallest, and ~~determining~~ setting the specified ~~"n" kind of~~ nozzle set as the determined nozzle set.

Claim 5 (Currently Amended) The optimizing method according to Claim 4, wherein the further calculating of ~~task~~ the number of tasks further comprises: ~~calculation step includes the following steps:~~

calculating a ~~task~~ number of tasks, for a case in which the plurality of components are mounted on a board, for using the mounting head to pick up as many of the ~~on which~~ L

components ~~are picked up as many~~ as possible, as a minimal task number; and

judging for each task, of the number of tasks calculated by the calculating of the number of tasks for using the mounting head, ~~number~~ whether or not it is possible to mount ~~all~~ the plurality of components by incrementing the calculated ~~minimum~~ minimal task number by 1, and obtaining a minimum task number, when the judging for each task judges that it is ~~judged as~~ possible to mount the plurality of components, as the ~~task~~ number of tasks required for mounting ~~all~~ the plurality of components using "n" kinds of nozzle sets.

Claim 6 (Currently Amended) The optimizing method according to Claim 5, wherein, in the further calculating of the number of tasks, ~~task number calculation step, a task~~ the number of tasks required for mounting the plurality of components by a nozzle set is incremented, ~~said task number of~~ the nozzle set, for which the number of tasks is incremented being from, ~~out of~~ a plurality of nozzle sets determined immediately before the further calculating of the number of tasks, and the incrementing of the number of tasks required for mounting the plurality of components resulting in ~~having~~ fewer "empty head" which is a state in which a mounting head is empty when performing a task for components fewer than ~~the number~~ L.

Claim 7 (Currently Amended) The optimizing method according to Claim 5, wherein the further calculating of the ~~task~~ number of tasks ~~calculation step~~ further ~~includes~~ comprises calculating the ~~task~~ number of tasks required for mounting all of the plurality of components by decrementing the calculated minimum task number by 1.

Claim 8 (Currently Amended) The optimizing method according to Claim 7, wherein, in the further calculating of the number of tasks ~~task number calculation step~~, the ~~task~~ number of tasks required for mounting the plurality of components by a nozzle set is decremented, ~~said task number of~~ the nozzle set, for which the number of tasks is decremented being from ~~out of plural~~ a plurality of nozzle sets determined immediately before the further calculating of the number of tasks, and the decrementing of the number of tasks required for mounting the plurality of

components resulting in ~~having~~ more "empty head" which is a state in which a mounting head is empty when performing a task for components fewer than ~~the number~~ L.

Claim 9 (Currently Amended) The optimizing method according to Claim 4,

wherein a ~~the~~ number of usable pickup nozzles is restricted depending on the type of pickup nozzles, and

wherein, in the determination of the nozzle set ~~determination step~~, when ~~the~~ "n" kinds of nozzle sets are respectively determined, a combination of a pickup nozzle and ~~the~~ a number of components to be mounted using ~~said~~ the pickup nozzle is specified to be ~~for the number~~ L or fewer within the restricted number of usable pickup nozzles ~~range~~.

Claim 10 (Currently Amended) The optimizing method according to Claim 4, wherein, in the further calculating of the number of tasks, ~~task number calculation step, the~~ possible combinations of pickup nozzles, for ~~the~~ each task ~~numbers~~ calculated using the respective "n" kinds of nozzle sets, are extracted, whether or not it is possible to mount ~~all~~ the plurality of components is sequentially judged for all of the extracted combinations of pickup nozzles, and a minimum task number, for which the sequentially judging judges that it is ~~judged as~~ possible to mount the plurality of components, is obtained as the ~~task~~ number of tasks required for mounting the plurality of components using "n" kinds of nozzle sets.

Claim 11 (Currently Amended) The optimizing method according to Claim 10, wherein, in the further calculating of the number of tasks, ~~task number calculation step,~~ the possible combinations of pickup nozzles are extracted from a restricted range of pickup nozzles specified by minimum and maximum task numbers, ~~said~~ the minimum task number ~~is~~ being a ~~task~~ number of tasks required for mounting as many of the plurality of components on a board ~~as many~~ as possible[[,]] using a mounting head by which L components are picked up, and ~~said~~ the maximum task number ~~is the~~ being a ~~number of components having the~~ largest number ~~out~~ of the components classified based on the type of pickup nozzles.

Claim 12 (Currently Amended) The optimizing method according to ~~Clam~~ Claim 4, wherein the further calculating of the number tasks further comprises: ~~task number calculation step includes:~~

a first calculation step of: calculating a ~~task~~ number of tasks, for a case in which the plurality of components are mounted on a board, for using a mounting head to pick up as many of the ~~on which~~ L components ~~are picked up as many~~ as possible, as a minimal task number; judging whether or not it is possible to mount ~~all~~ the plurality of components for each task of the number of tasks calculated by the first calculation step ~~number~~ by incrementing the calculated ~~minimum~~ minimal task number by 1; and obtaining a minimum task number, when the judging of each task judges ~~judged as~~ that it is possible ~~as~~ to mount the plurality of components, as the ~~task~~ number of tasks required for mounting the plurality of components using "n" kinds of nozzle sets;

a second calculation step of: extracting ~~the~~ possible combinations of pickup nozzles, for ~~the~~ each task ~~numbers~~ calculated ~~by~~ using the respective "n" kinds of nozzle sets; sequentially judging ~~sequentially~~ whether or not it is possible to mount ~~all~~ the plurality of components for all of the extracted combinations of pickup nozzles; and obtaining a minimum task number, for which the sequentially judging judges that it is ~~judged as~~ possible to mount the plurality of components, as the ~~task~~ number of tasks required for mounting the plurality of components ~~calculated~~ using ~~the~~ "n" kinds of nozzle sets; and

~~a selection step of~~ executing ~~selectively~~ either the first calculation step or the second calculation step.

Claim 13 (Currently Amended) The optimizing method according to Claim 2, wherein, in the determination of the nozzle set ~~determination step~~, a nozzle set which obtains ~~the~~ a smallest evaluated value S is determined as the nozzle set that reduces ~~a~~ the mounting time, ~~said~~ the smallest evaluated value S is calculated using $S=X+h \cdot N$, where N indicates the number of times of interchanging the pickup nozzles, X indicates the total ~~task~~ number of tasks, and h indicates a coefficient for converting the time taken ~~by interchanging~~ to interchange the pickup

nozzles into a task number.

Claim 14 (Currently Amended) The optimizing method according to Claim 2, further comprising ~~a nozzle pattern determination step of~~ determining a nozzle pattern in which a type of pickup nozzle is assigned to each of a plurality of heads constituting ~~composing~~ the mounting head for all of the tasks required for mounting the plurality of components, while maintaining the nozzle set determined in the determination of the nozzle set ~~determination step,~~.

Claim 15 (Currently Amended) The optimizing method according to Claim 2,

wherein the mounter includes a nozzle station at which the pickup nozzles are arranged, and

wherein the optimizing method further comprises ~~a nozzle station arrangement determination step of~~ determining a combination of a type of pickup nozzle ~~nozzles~~ to be arranged at the nozzle station and a place for the arrangement based on the nozzle set determined in the determination of the nozzle set ~~determination step~~.

Claim 16 (Currently Amended) The optimizing method according to Claim 2, wherein, in the determination of the mounting order ~~determination step~~, the components are classified ~~into~~ as small components ~~and~~ or general components based on heights of the components, the order of the array ~~order~~ of ~~the~~ component feeders and the component mounting order for the small components are determined so that ~~the~~ a number of components to be picked up per task by the mounting head increases, while the order of the array ~~order~~ of component feeders and the component mounting order for the general components are determined based on ~~in a search of~~ a mounting order which reduces the mounting time while switching ~~the~~ an order of mounting components.

Claim 17 (Currently Amended) The optimizing method according to Claim 1, wherein ~~in~~ the determination of the nozzle set ~~determination step,~~ determines the nozzle set ~~and the task~~

~~number are determined, said nozzle set~~ for mounting ~~all~~ the plurality of components with the smallest possible number of tasks ~~task number,~~ without interchanging the pickup nozzles attached to the mounting head.

Claim 18 (Currently Amended) The optimizing method according to Claim 17, wherein the determination of the nozzle set further comprises: ~~determination step includes:~~

~~an initial nozzle set calculation step of~~ for each type of pickup nozzle, initially calculating ~~the~~ a number of pickup nozzles ~~for each type as~~ of an initial nozzle set based on ~~the~~ a number of components to be picked up, respectively, by the different types of pickup nozzles;

~~an initial task number calculation step of~~ initially calculating a total ~~task~~ number of tasks for mounting ~~all~~ the plurality of components based on ~~the~~ a number of components corresponding to the calculated number of pickup nozzles of the initial nozzle set;

~~a task number calculation step of~~ calculating a total ~~task~~ number of tasks for mounting the plurality of components when the number of pickup nozzles of the initial nozzle set is incremented or decremented by 1 for each type of pickup nozzle of the initial nozzle set; and

~~a judgment step of~~ judging whether or not the total ~~task~~ number of tasks calculated in the ~~task number calculation step~~ calculating of the total number of tasks is smaller than the total ~~task~~ number of tasks calculated in the initially calculating of the total number of tasks ~~initial task number calculation step, and~~ when the former is smaller than the latter, ~~the~~ judgment is made as to ~~on~~ whether or not the decremented or incremented total ~~task~~ number of tasks becomes smaller after the incremented or decremented nozzle set has been updated as a latest nozzle set, and when the former is not smaller than the latter, ~~the~~ a previous nozzle set and the total ~~task~~ number of tasks ~~for said~~ of the previous nozzle set are determined as the initial nozzle set and the number of tasks ~~task~~, respectively ~~number~~.

Claim 19 (Currently Amended) The optimizing method according to Claim 18,

wherein the respective plurality of components belong to one of a plurality of component groups classified based on heights of the components, and

wherein the ~~task~~ calculating of the total number of tasks further comprises: ~~calculation step includes:~~

~~a component group task number calculation step of~~ calculating a respective ~~task~~ number of tasks required for mounting ~~all~~ the components ~~belonging to~~ of each ~~of said~~ component group ~~groups~~; and

~~a total task number calculation step of~~ calculating a total group ~~task~~ number of tasks by totaling each of the respective numbers of tasks ~~task numbers~~ calculated by the calculating of the respective number of tasks ~~in units of component groups~~.

Claim 20 (Currently Amended) The optimizing method according to Claim 19, wherein, in the calculating of the respective number of tasks ~~component group task number calculation step~~, when a component group includes a plurality of ~~plural~~ types of components to be picked up using a plurality of pickup nozzles, a maximum task number, out of task numbers corresponding, respectively, to the plurality of pickup nozzles, is obtained as a ~~task~~ number of tasks of the component group[[,]].

Claim 21 (Currently Amended) The optimizing method according to Claim 1 further comprising:

~~a component group allocation step of~~ allocating the plurality of components to two or more mounters in units of component groups so that ~~task numbers~~ a number of tasks of each of ~~at~~ the two or more mounters is averaged, when a task is a group of components to be mounted by one iteration of the repeated series of processes where the mounting head picks up, transports, and mounts the components; and

~~a component moving step of~~ modifying the allocation of the allocating of the plurality of components by moving a part of the components allocated to a mounter with a larger ~~task~~ number of tasks to a mounter with a smaller ~~task~~ number of tasks so that all of the allocated components are mounted without interchanging the pickup nozzles attached to the mounting head and the number of tasks of each of ~~task numbers for~~ the two or more mounters is averaged.

Claim 22 (Currently Amended) The optimizing method according to Claim 21,

wherein, in the allocating of the plurality of components ~~component group allocation step~~, a process ~~processing~~ of modifying the allocation by sequentially moving ~~sequentially~~ the component groups allocated to the mounter with ~~a~~ the larger ~~task~~ number of tasks to another mounter ~~that is connected~~ adjacently connected to ~~said~~ the mounter with the larger number of tasks after having allocated all of the component groups to the two or more mounters so that the component groups of low components are allocated to a mounter positioned upstream in a production line, is repeated until a size relation between the ~~task numbers~~ number of tasks of ~~for~~ the two mounters reverses, and when the size relation is reversed, the previous state in which the component groups are allocated is determined as a final state.

Claim 23 (Currently Amended) The optimizing method according to Claim 21, wherein, in the modifying of the allocation ~~component moving step~~, the components to be moved are determined based on a difference between the ~~task numbers~~ number of tasks of ~~at~~ the respective two or more mounters for mounting the components allocated in the allocating of the plurality of components ~~component group allocation step~~, and the determined components are moved.

Claim 24 (Currently Amended) The optimizing method according to Claim 23, wherein, in the modifying of the allocation ~~component moving step~~, when a component ~~such that requires~~ requiring a new pickup nozzle is moved from ~~the~~ a second mounter to ~~the~~ a first mounter, a space for the new pickup nozzle is retained by determining a pickup nozzle, with which a ~~task~~ number of tasks becomes the smallest, ~~out of~~ from a plurality of pickup nozzles assigned to ~~a~~ the first mounter, ~~said task~~ the number of tasks being incremented by decrementing ~~the~~ a number of pickup nozzles by 1.

Claim 25 (Currently Amended) The optimizing method according to Claim 1 further comprising:

~~a nozzle allocation step of~~ allocating pickup nozzles by determining types and numbers of

pickup nozzles for respective two or more mounters according to types and numbers of components allocated to the respective two or more mounters;

~~a task number calculation step of~~ calculating a number of tasks required for mounting components allocated to the mounters by modifying the number of pickup nozzles determined in the allocating of the pickup nozzles ~~nozzle allocation step~~ based on a restriction on a nozzle resource number that is ~~the~~ a number of usable pickup nozzles, and ~~of~~ calculating a ~~task~~ number of tasks for ~~at~~ each mounter[[,]] such that ~~the types and numbers of pickup nozzles for mounting~~ all of the components allocated to each mounter can be mounted without interchanging the pickup nozzles[[,]] based on the number of pickup nozzles after the modification and the corresponding number of components; and

~~a nozzle number adjustment step of~~ incrementing or decrementing the number of pickup nozzles allocated to each mounter so that a difference between the number of tasks required by each mounter ~~mounters in task numbers~~ calculated in the calculating of the number of tasks required for mounting components ~~task number calculation step~~ is reduced.

Claim 26 (Currently Amended) The optimizing method according to Claim 25, wherein, in the incrementing or decrementing of the number of pickup nozzles ~~nozzle number adjustment step~~, a difference between ~~in task numbers~~ a number of tasks ~~between the~~ of a first and a second mounter ~~mounters~~ is reduced by incrementing the number of pickup nozzles allocated to the first mounter ~~with~~ having a larger ~~task~~ number of tasks by ~~the number~~ "n" and decrementing the pickup nozzles allocated to the second mounter ~~with~~ having a smaller ~~task~~ number of tasks by ~~the number~~ "n", when ~~the~~ pickup nozzles of the same type are allocated to the first and second mounters.

Claim 27 (Currently Amended) An optimizing apparatus that optimizes, using a computer, a component mounting order in which a mounter, equipped with a mounting head, picks up, at maximum, L components, L being no less than 2, from an array of component feeders that hold components, and mounts the components on a board,

wherein the mounting head has, at maximum, L pickup nozzles attached thereto for picking up the components~~, L being no less than 2~~, and

wherein a plurality of components, of which the mounting order is to be optimized, includes a plurality of ~~include plural~~ types of components ~~which are~~ to be picked up using no less than 2 pickup nozzles of different types, ~~and~~

the optimizing apparatus comprising:

a nozzle set determination unit operable to determine a nozzle set, from a plurality of pickup nozzles, for mounting ~~all~~ the plurality of components ~~with~~ using a smallest possible number of tasks ~~task number~~, where a nozzle set is a combination of pickup nozzles in which (i) only the types of the pickup nozzles and a number of the pickup nozzles to be attached to the mounting head are previously set and (ii) a correspondence between the types of the pickup nozzles and mounting positions of the pickup nozzles is not previously set, and where a task is a group of components to be mounted by one iteration of ~~the~~ a repeated series of processes where the mounting head picks up, transports, and mounts the components; and

a mounting order determination unit operable to determine an order of the array-~~order~~ of component feeders and ~~the~~ a component mounting order, while maintaining the determined nozzle set.

Claim 28 (Currently Amended) A mounter ~~equipped with~~ comprising a mounting head which picks up, at maximum, L components, L being no less than 2, from an array of component feeders that hold components, and mounts the components on a board,

wherein the components are mounted in a mounting ~~an~~ order ~~of mounting components,~~ optimized by the optimizing method according to Claim 1.

Claim 29 (Currently Amended) A computer-readable storage medium having a program stored thereon, the program for ~~an~~ optimizing ~~apparatus that optimizes, using a computer,~~ a component mounting order in which a mounter, equipped with a mounting head, picks up, at maximum, L components, L being no less than 2, from an array of component feeders that hold

components, and mounts the components on a board, the program causing ~~the~~ a computer to execute ~~the steps included in~~ the optimizing method according to Claim 1.

Claim 30 (Cancelled)